Passive Sound Localization in the Barn Owl

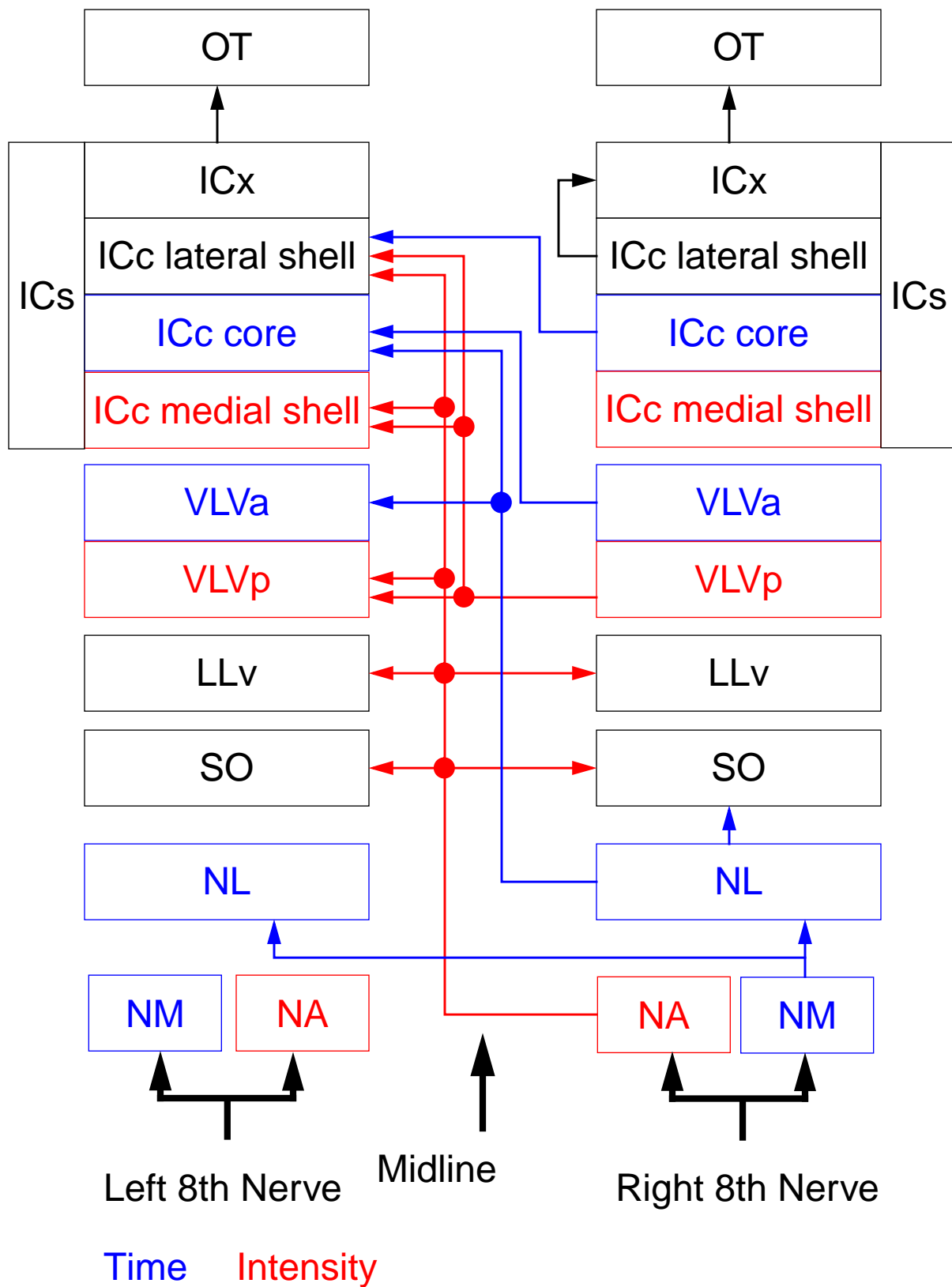Clay Spence and John Pearson

Sarnoff Corporation
CN5300
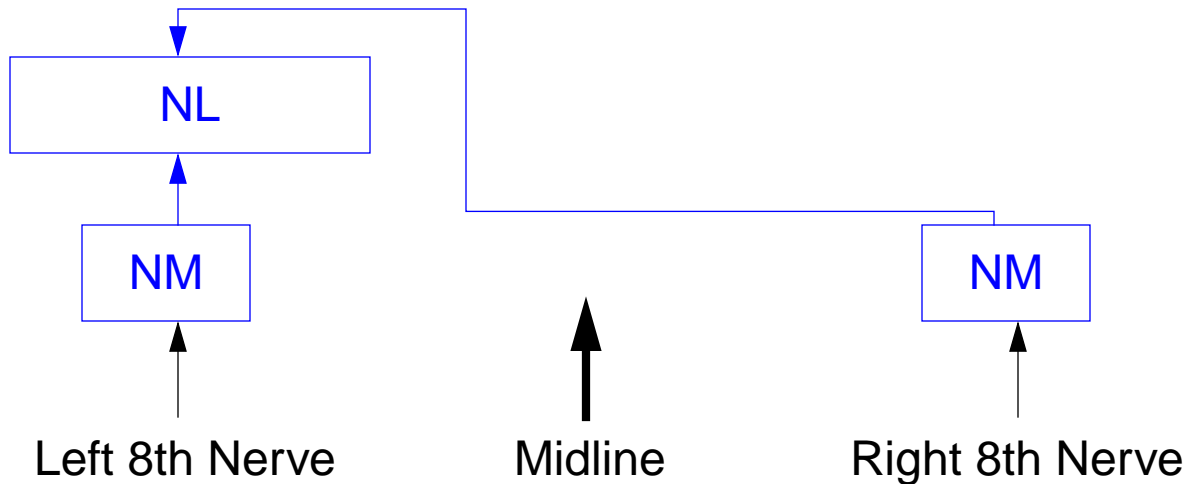Princeton, NJ 08543-5300
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Standard Form 298 (Rev. 8-98)
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Block Diagram of the Owl's Auditory Localization System

OT		OT
ICx		**ICx**
ICc lateral shell		ICc lateral shell
ICc core		ICc core
ICc medial shell		ICc medial shell
VLVa		VLVa
VLVp		VLVp
LLv		LLv
SO		SO
NL		NL
NM NA		NA NM

Left 8th Nerve   Midline   Right 8th Nerve

Time   Intensity

Timing (ITD) Pathway

NL

NM   NM

Left 8th Nerve   Midline   Right 8th Nerve

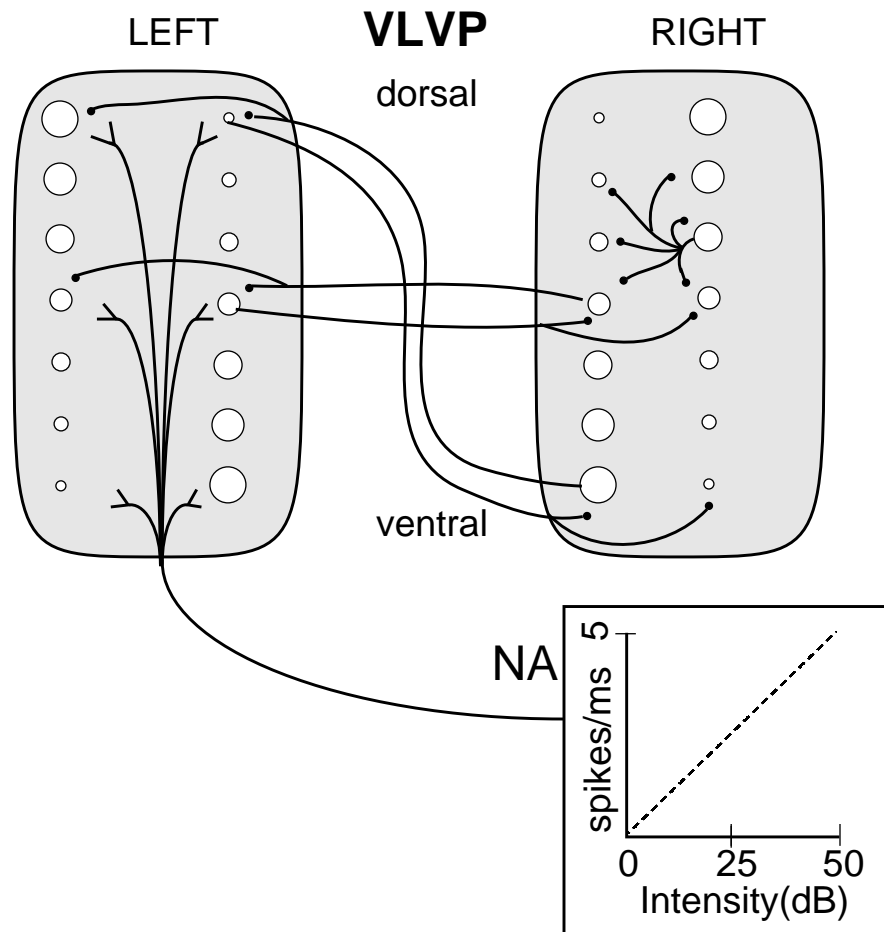Inside NL:

A   C   A   C   A   C   A
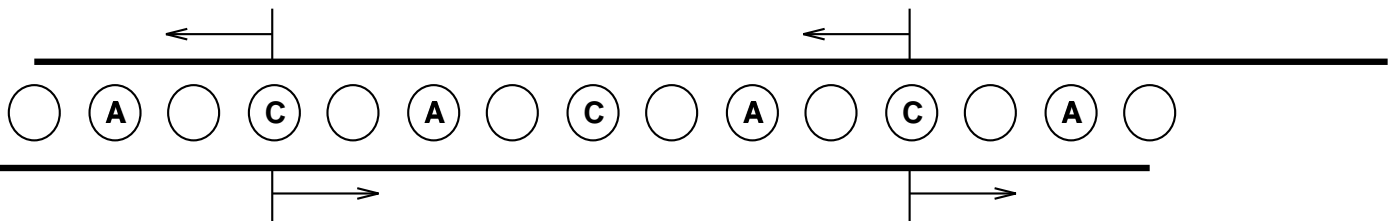
NM neurons pull out timing information (phase lock).

NM axons act as delay lines (Jeffress, 1948).

NL Neurons act as coincidence detectors (?).

Map of ITD (interaural time delay) vs. frequency.

Intensity (IID) pathway

LEFT **VLVP** RIGHT
dorsal

NA

ventral

spikes/ms
5

0   25   50
Intensity(dB)

NA neurons pull out sound intensity, insensitive to phase.
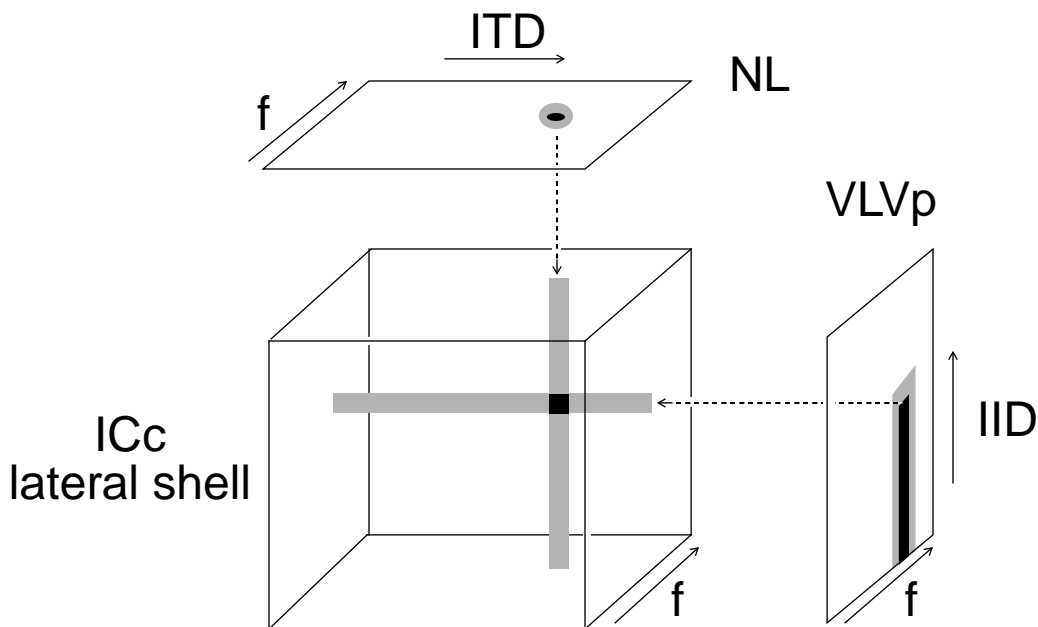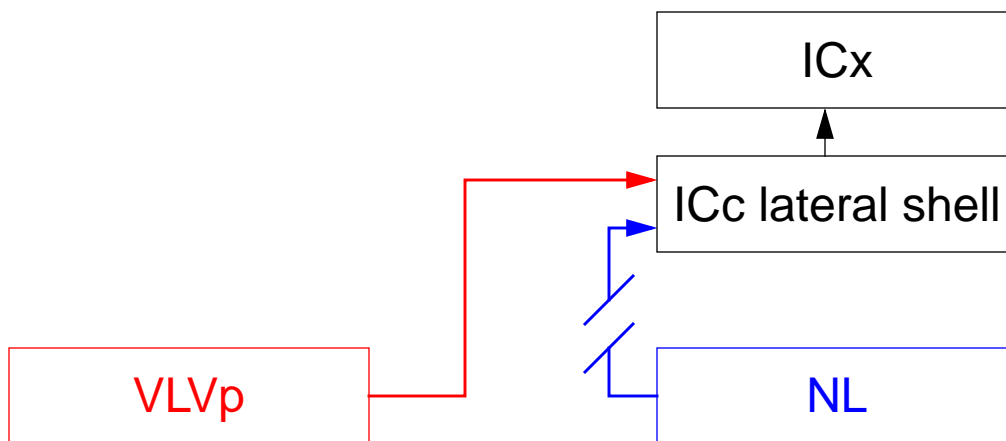
NA excites contralateral VLVp.

Two VLVps inhibit each other;
    compete.

Inhibition varies with position.

Map of interaural intensity difference (IID) vs. frequency.

Combining ITD and IID to make a Space Map

Model: Combine IID and ITD *before* summing frequencies, works with multiple sources.

ICc lateral shell resembles this, more complex.

Other interesting problems in the owl

- Visual/auditory fusion in the optic tectum (OT); adaptive alignment ICx.

- ITD disambiguation (combine frequencies).

- Details of VLVp connections and dynamics.

- IID tuning mechanism in ICc lateral shell.

- Dependence on average binaural intensity in OT.

Problems we have yet to work on:

- Motion sensitivity in IC.

- Adaptation in VLVp.